

HA1631S01/02/03/04 Series

Single CMOS Comparator (Push Pull/Open Drain Output)

REJ03D0056-0100Z
Rev.1.00
2003.08.08

Description

The HA1631S01/02/03/04 are low power single CMOS Comparator featuring low voltage operation with typical current supply of 5 μ A/50 μ A. They are designed to operate from a single power supply. HA1631S01/02 have push-pull full swing outputs that allow direct connections to logic devices. The Open Drain version HA1631S03/04 enable Output Level shifting through external pull up resistors. Available in an ultra-small CMPAK-5 package, they occupy only 1/8 the area of the SOP-8 package.

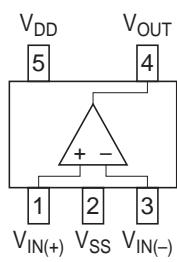
Features

- Low supply current
HA1631S01/03: $I_{DDtyp} = 5 \mu A$ ($V_{DD} = 3.0 V$)
HA1631S02/04: $I_{DDtyp} = 50 \mu A$ ($V_{DD} = 3.0 V$)
- Low voltage operation: $V_{DD} = 1.8$ to $5.5 V$
- Low input offset voltage: $V_{IOmax} = 5 mV$
- Low input bias current: $I_{IBtyp} = 1 pA$
- Maximum output voltage: $V_{OHmin} = 2.9 V$ (at $V_{DD} = 3.0 V$)
- Input common voltage range includes ground
- On-chip ESD protection
- Available in CMPAK-5 and MPAK-5 package using Pb free lead frame

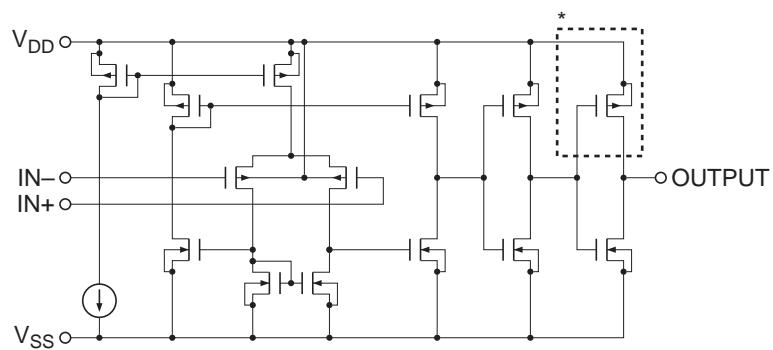
Outline

	
CMPAK-5V	MPAK-5V
HA1631S01CM	HA1631S01LP
HA1631S02CM	HA1631S02LP
HA1631S03CM	HA1631S03LP
HA1631S04CM	HA1631S04LP

Pin Arrangement



Equivalent Circuit



Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Ratings	Unit	Remarks
Supply voltage	V _{DD}	7.0	V	
Differential input voltage	V _{IN(dif)}	-V _{DD} to +V _{DD}	V	Note 1
Input voltage	V _{IN}	0.1 to +V _{DD}	V	
Output current	I _{OUT}	28	mA	Note 2
Power dissipation	P _T	80/120	mW	CMPAK/MPAK
Operating temperature	T _{OPR}	-40 to +85	°C	
Storage temperature	T _{STG}	-55 to +125	°C	

Notes: 1. Do not apply input voltage exceeding V_{DD} or 7 V.

2. The maximum output current is the maximum allowable value for continuous operation.

Electrical Characteristics(Ta = 25°C, V_{DD} = 3.0 V, V_{SS} = 0 V)

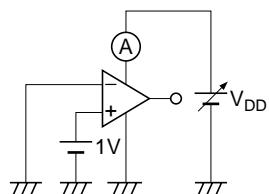
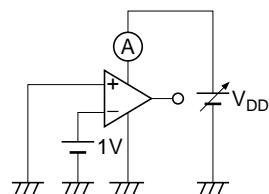
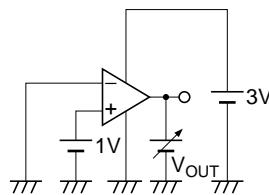
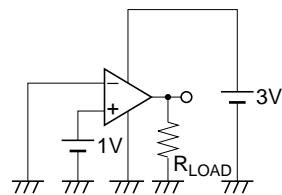
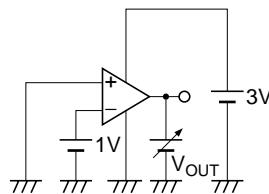
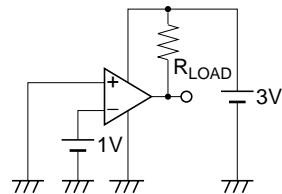
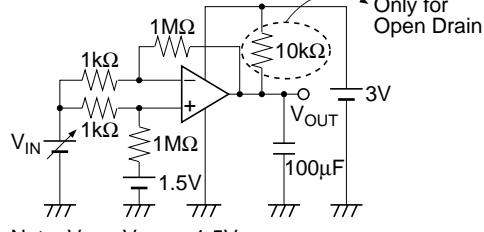
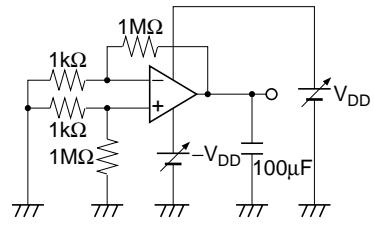
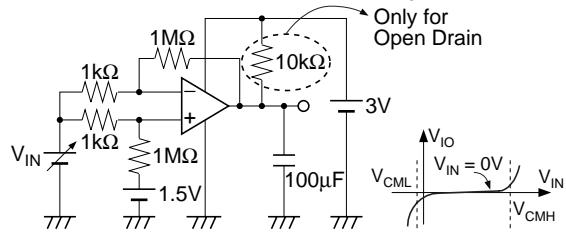
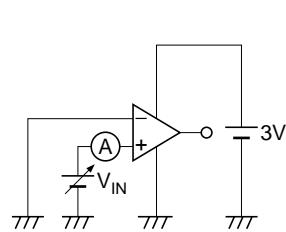
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input offset voltage	V _{IO}	—	—	5	mV	V _{IN} = V _{DD} /2, R _L = 1MΩ
Input bias current	I _{IB}	—	(1)	100	pA	V _{IN} = V _{DD} /2
Input offset current	I _{IO}	—	(1)	100	pA	V _{IN} = V _{DD} /2
Common mode input voltage range	V _{CM}	-0.1	—	2.1	V	
Supply current	HA1631S01/03	I _{DD}	—	5	μA	V _{DD} = 3V, V _{IN+} = 1V, V _{IN-} = 0V
	HA1631S02/04		—	50	μA	
Response time	HA1631S01	TP _{LH}	—	(1.20)	μs	1V DC bias,
	HA1631S01/03	TP _{HL}	—	(0.55)	μs	100mV overdrive,
	HA1631S01	t _r	—	(24)	ns	C _L = 15pF
	HA1631S01/03	t _f	—	(7)	ns	
	HA1631S02	TP _{LH}	—	(0.33)	μs	
	HA1631S02/04	TP _{HL}	—	(0.17)	μs	
	HA1631S02	t _r	—	(12)	ns	
	HA1631S02/04	t _f	—	(7)	ns	
Output source current (HA1631S01/02)	I _{OSOURCE}	6	13	—	mA	V _{out} = 2.5V
Output sink current	I _{OSINK}	7	14	—	mA	V _{out} = 0.5V
Common mode rejection ratio	HA1631S01/03	CMRR	60	80	dB	V _{IN1} = 0V, V _{IN2} = 2V
	HA1631S02/04		50	70	dB	
Power supply rejection ratio	PSRR	60	80	—	dB	V _{DD1} = 1.8V, V _{DD2} = 5.5V
Output voltage high	V _{OH}	V _{DD} -0.1	—	—	V	R _L = 10kΩ to V _{SS}
Output voltage low	V _{OL}	—	—	0.1	V	R _L = 10kΩ to V _{DD}
Output leakage current (Only for HA1631S03/04)	I _{LO}	—	(0.1)	—	nA	V _{IN+} = 1V, V _{IN-} = 0V, V _O = 3V
Operating voltage range	V _{OPR}	1.8	—	5.5	V	

Note: (): Design specification

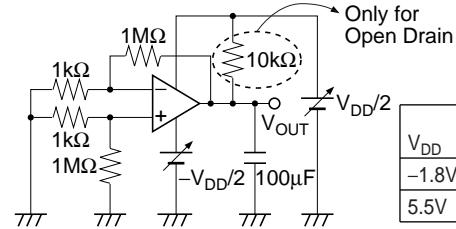
Table of Graphs

Electrical Characteristics		HA1631S01 Figure	HA1631S02 Figure	HA1631S03 Figure	HA1631S04 Figure	Test Circuit No.
Supply current	I_{DD}	vs. Supply voltage(Out H)	1-1	2-1	3-1	4-1
		vs. Supply voltage(Out L)	1-2	2-2	3-2	4-2
		vs. Temperature(Out H)	1-3	2-3	3-3	4-3
Output high voltage	V_{OH}	vs. Rload	1-18	2-18	3-4	4-4
Output source current	$I_{OSOURCE}$	vs. Output high voltage	1-4	2-4	—	5
Output low voltage	V_{OL}	vs. Rload	1-17	2-17	3-14	4-14
Output sink current	I_{OSINK}	vs. Output low voltage	1-5	2-5	3-4	4-4
Input offset voltage	V_{IO}	vs. Supply voltage	1-6	2-6	3-5	4-5
		vs. Temperature	1-7	2-7	3-6	4-6
Common mode input voltage range	V_{CM}	vs. Temperature	1-8	2-8	3-7	4-7
Power supply rejection ratio	PSRR	vs. Supply voltage	1-9	2-9	3-8	4-8
Common mode rejection ratio	CMRR	vs. Input voltage	1-10	2-10	3-9	4-9
Input bias current	I_B	vs. Temperature	1-11	2-11	3-10	4-10
		vs. Input voltage	1-12	2-12	3-11	4-11
Falling time	t_f	vs. Temperature	1-13	2-13	3-12	4-12
		vs. Cload	1-15	2-15	3-13	4-13
		Time waveform	1-20	2-20	3-15	4-15
Rising time	t_r	vs. Temperature	1-14	2-14	—	—
		vs. Cload	1-16	2-16	—	—
		Time waveform	1-19	2-19	—	—
Propagation delay time	TP_{LH}	Time waveform	1-21	2-21	—	—
	TP_{HL}	Time waveform	1-22	2-22	3-16, 3-17	4-16, 4-17
						13

Test Circuits

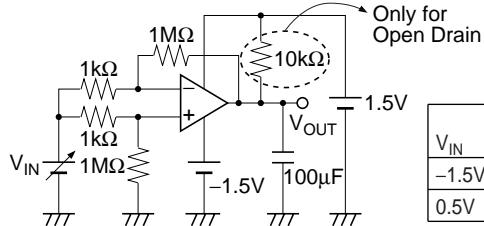
1. Supply Current, I_{DD} (Output High)2. Supply Current, I_{DD} (Output Low)3. Output Source Current, $I_{OSOURCE}$ 4. Output High Voltage, V_{OH} (Output High)5. Output Sink Current, I_{OSINK} 6. Output Low Voltage, V_{OL} (Output Low)7. Input Offset Voltage, V_{IO} Note: $V_{IO} = V_{OUT} - 1.5V$ 8. Input Offset Voltage vs. V_{DD} 9. Common Mode Input Voltage Range, V_{CM} Note: V_{CML} and V_{CMH} are values of V_{IN} when V_{IO} changes more than 50dB taking $V_{IN} = 0V$ as reference.10. Input Bias Current, I_{IB} 

11. Power Supply Rejection Ratio, PSRR



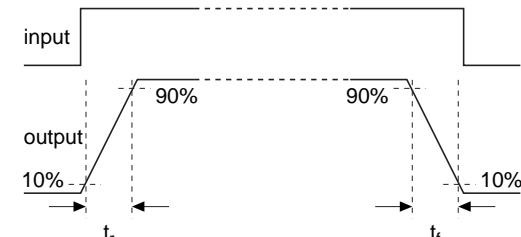
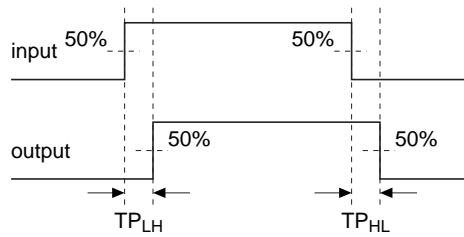
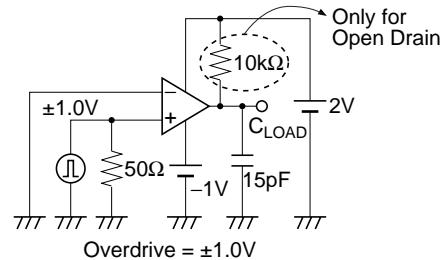
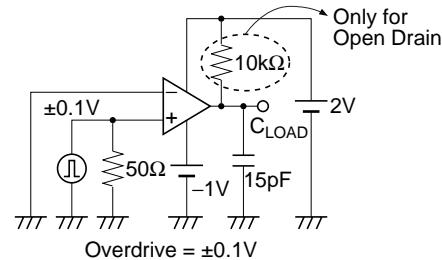
V _{DD}	Measure Point	Calculate V _{IO}	PSRR Calculation
-1.8V	V _{OUT1}	V _{IO1} = V _{OUT1} /1000	PSRR = $20\log_{10} \frac{ (V_{IO2} - V_{IO1}) }{5.5V - 1.8V}$
5.5V	V _{OUT2}	V _{IO2} = V _{OUT2} /1000	

12. Common Mode Rejection Ratio, CMRR

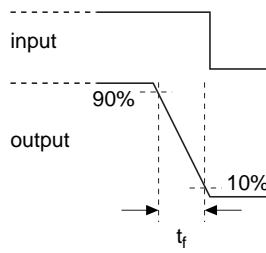
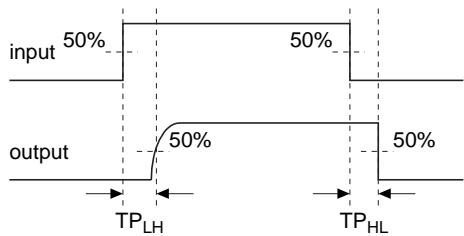


V _{IN}	Measure Point	Calculate V _{IO}	CMRR Calculation
-1.5V	V _{OUT1}	V _{IO1} = V _{OUT1} /1000	CMRR = $20\log_{10} \frac{ (V_{IO2} - V_{IO1}) }{0.5V - (-1.5V)}$
0.5V	V _{OUT2}	V _{IO2} = V _{OUT2} /1000	

13. Falling Time, Rising Time, Propagation Delay Time T_{PLH}, T_{PHL}



Only for Push Pull HA1631S01/02



Only for Open Drain HA1631S03/04

Main Characteristics

Figure 1-1 HA1631S01
Supply Current vs. Supply Voltage
(Output High)

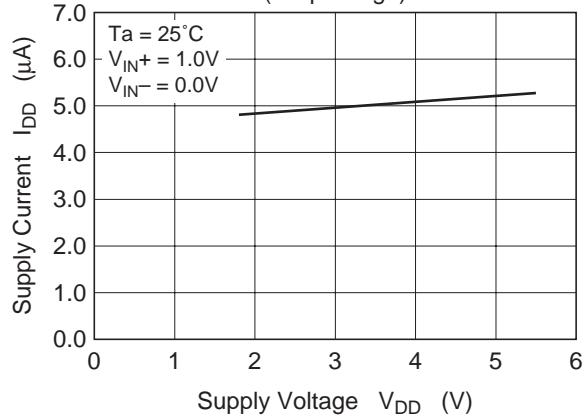


Figure 1-2 HA1631S01
Supply Current vs. Supply Voltage
(Output Low)

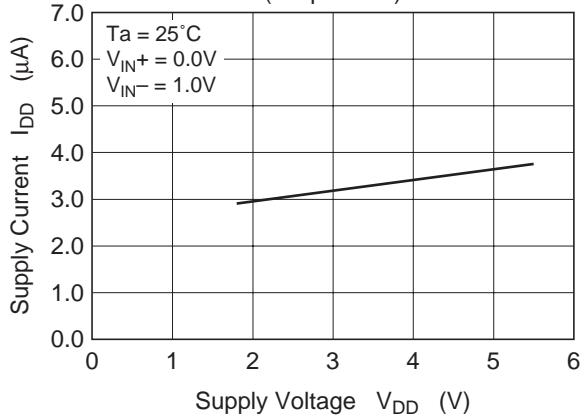


Figure 1-3 HA1631S01
Supply Current vs. Ambient Temperature

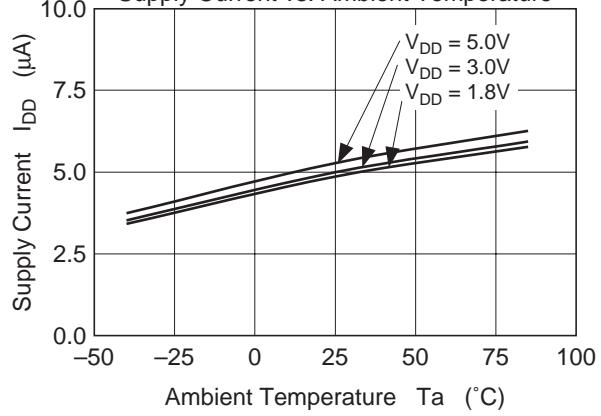


Figure 1-4 HA1631S01
Output High Voltage vs. Output Source Current

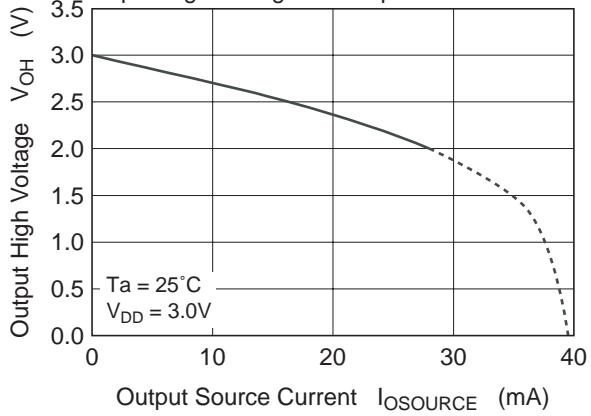


Figure 1-5 HA1631S01
Output Low Voltage vs. Output Sink Current

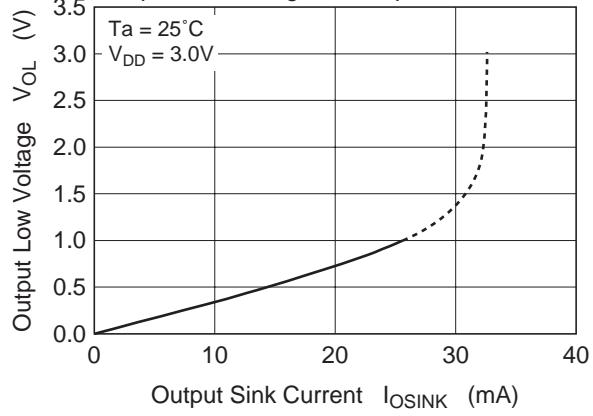


Figure 1-6 HA1631S01
Input Offset Voltage vs. Supply Voltage

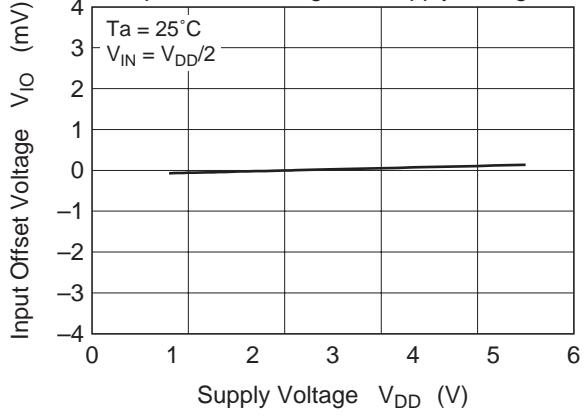


Figure 1-7 HA1631S01

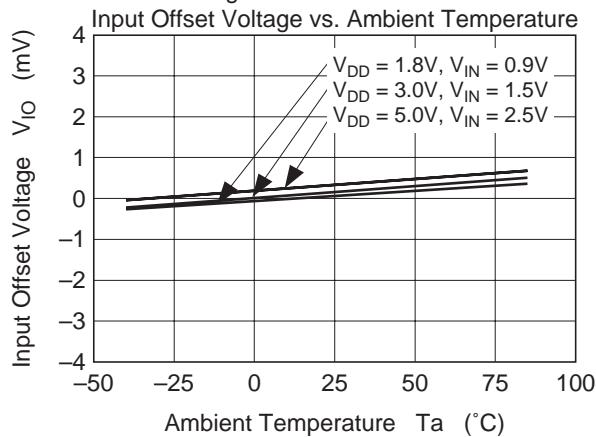


Figure 1-8 HA1631S01

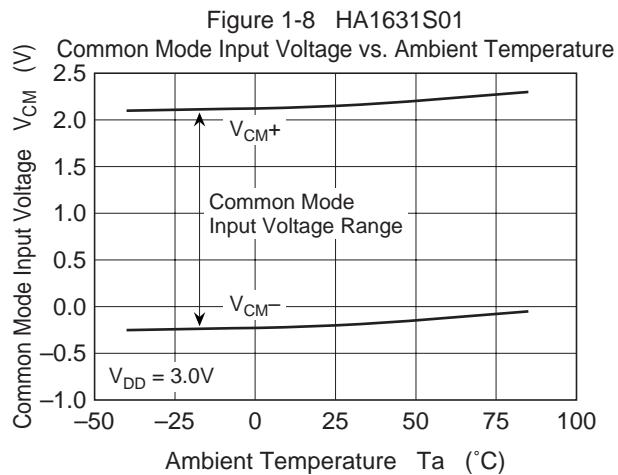


Figure 1-9 HA1631S01

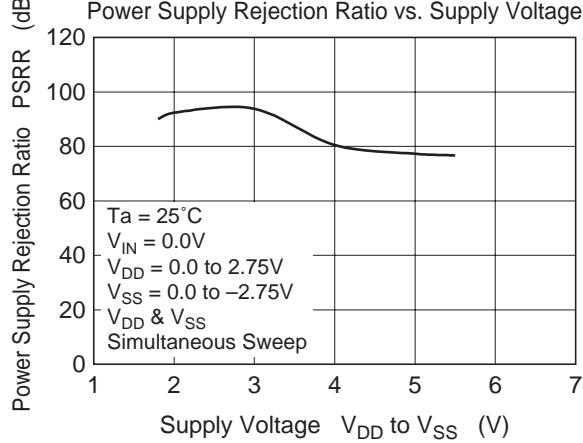


Figure 1-10 HA1631S01

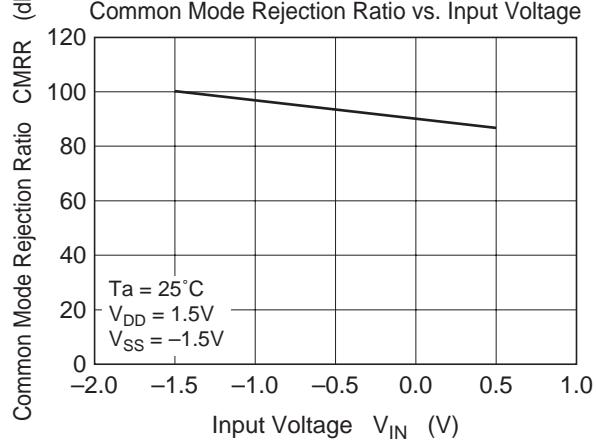


Figure 1-11 HA1631S01

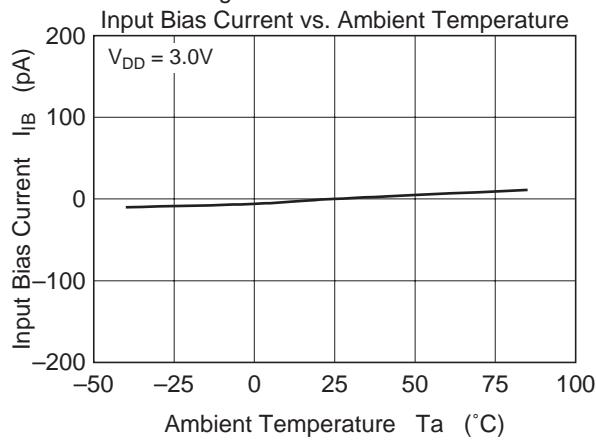
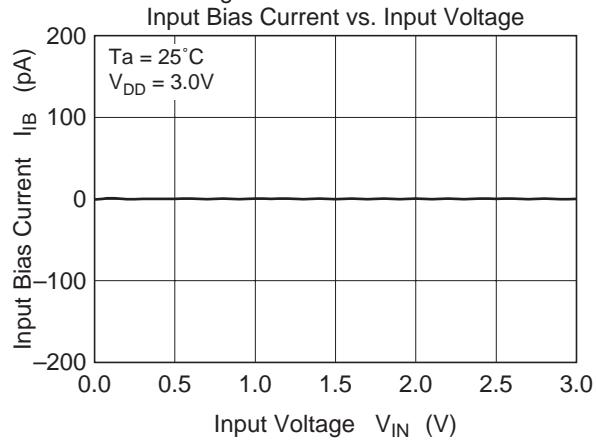


Figure 1-12 HA1631S01



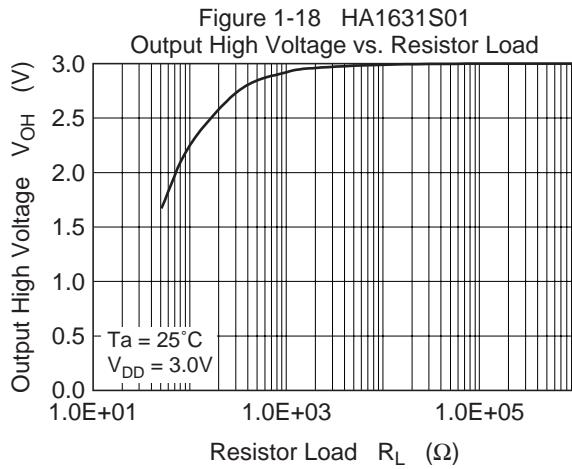
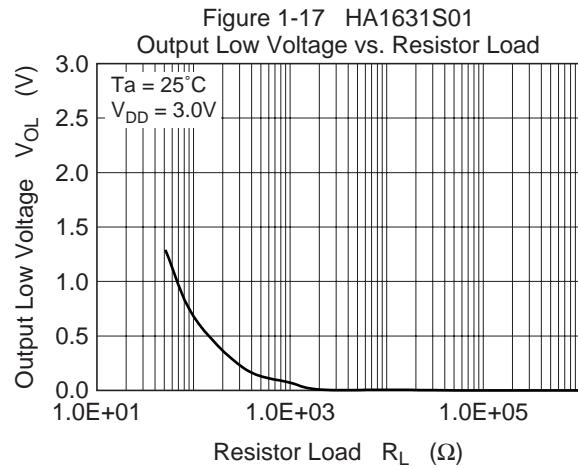
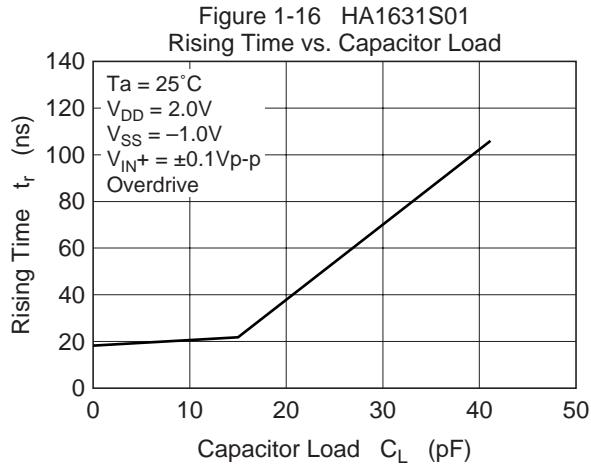
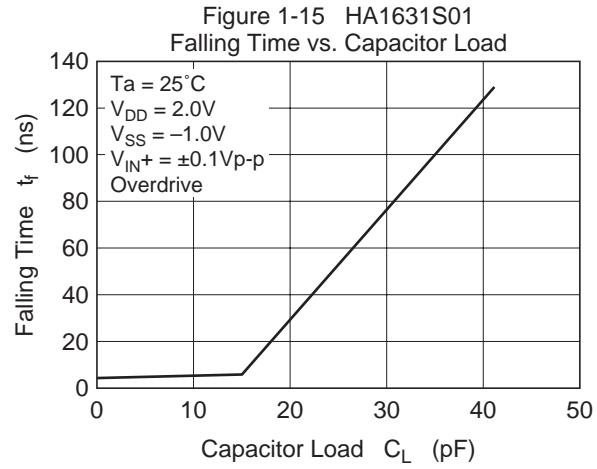
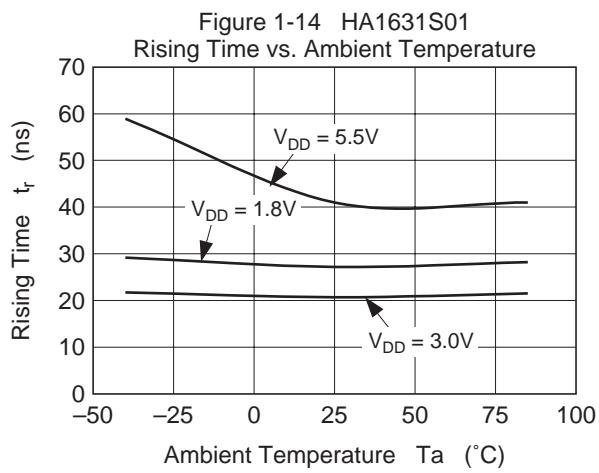
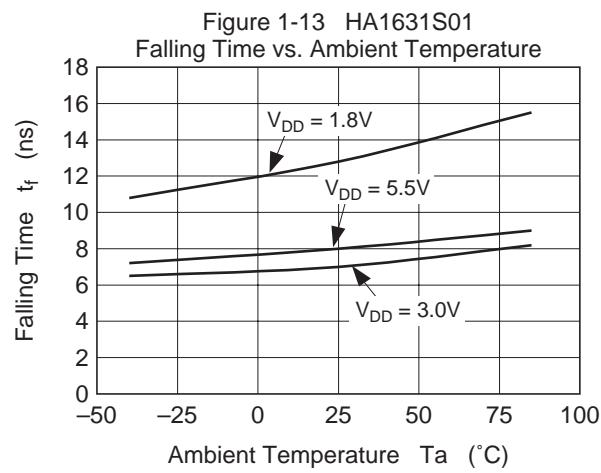


Figure 1-19 HA1631S01
Rising Time, t_r
(Overdrive = $\pm 0.1\text{Vp-p}$)

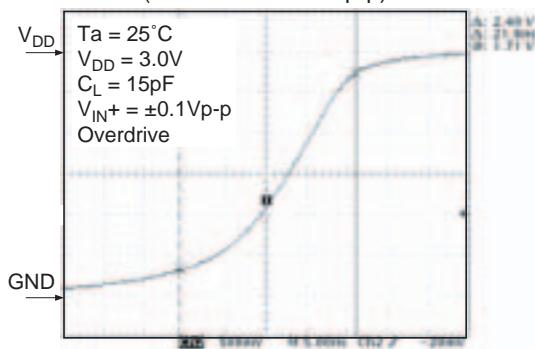


Figure 1-20 HA1631S01
Falling Time, t_f
(Overdrive = $\pm 0.1\text{Vp-p}$)

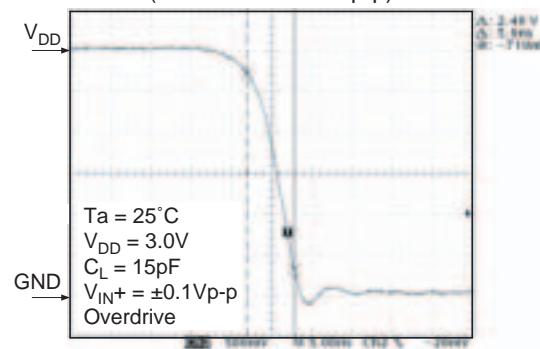


Figure 1-21 HA1631S01
TP_{LH} Transient Response
(Overdrive = $\pm 0.1\text{Vp-p}$)

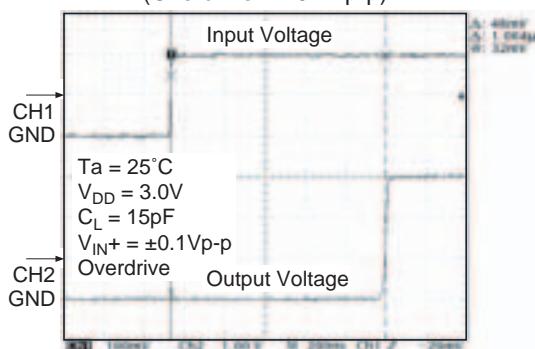


Figure 1-22 HA1631S01
TP_{HL} Transient Response
(Overdrive = $\pm 0.1\text{Vp-p}$)

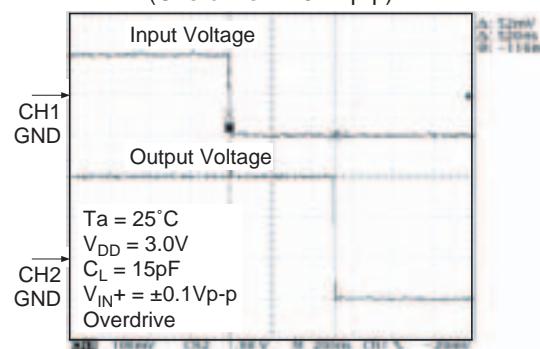


Figure 2-1 HA1631S02
Supply Current vs. Supply Voltage
(Output High)

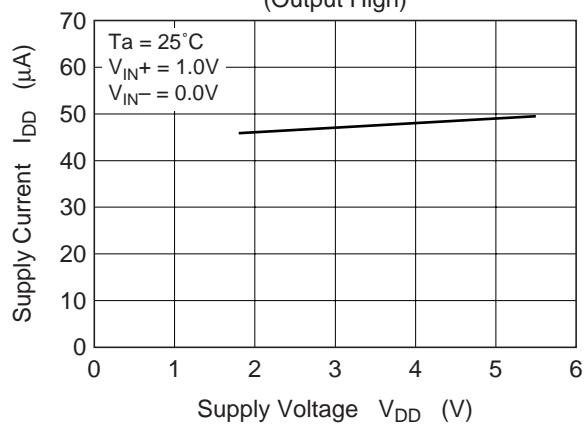


Figure 2-2 HA1631S02
Supply Current vs. Supply Voltage
(Output Low)

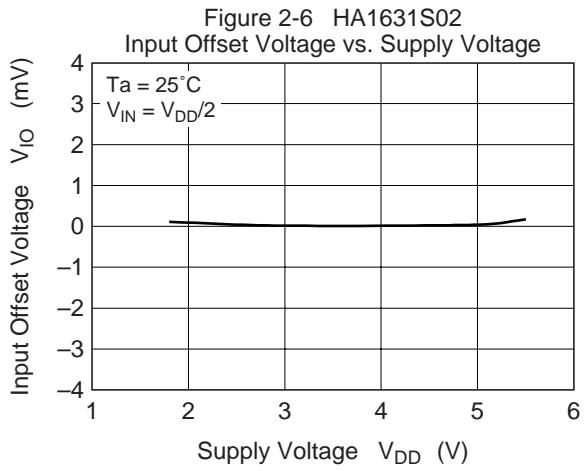
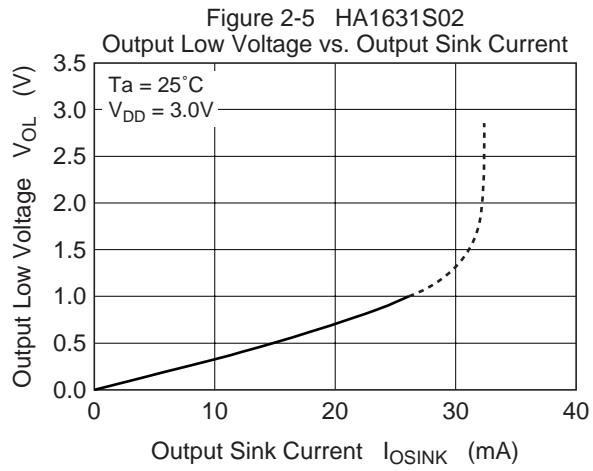
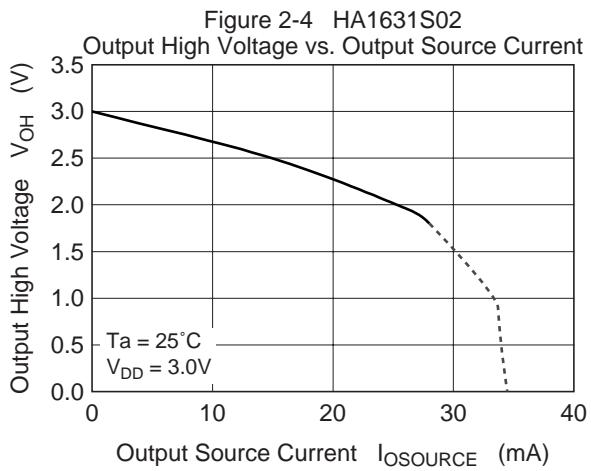
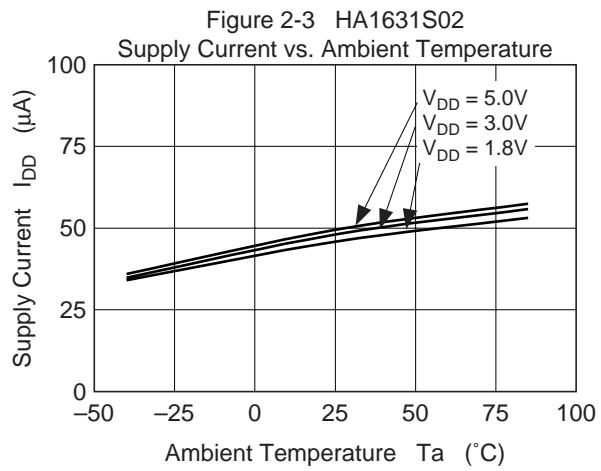
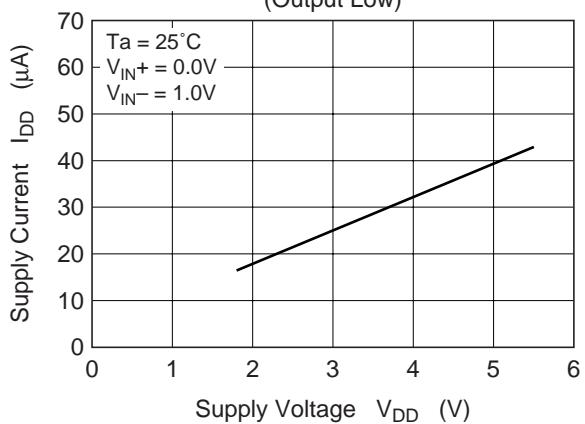


Figure 2-7 HA1631S02

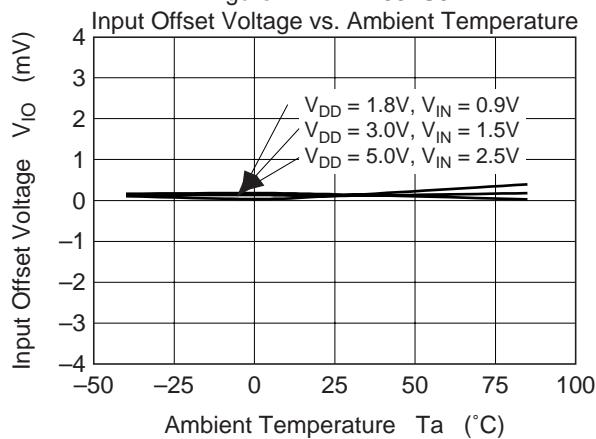


Figure 2-8 HA1631S02

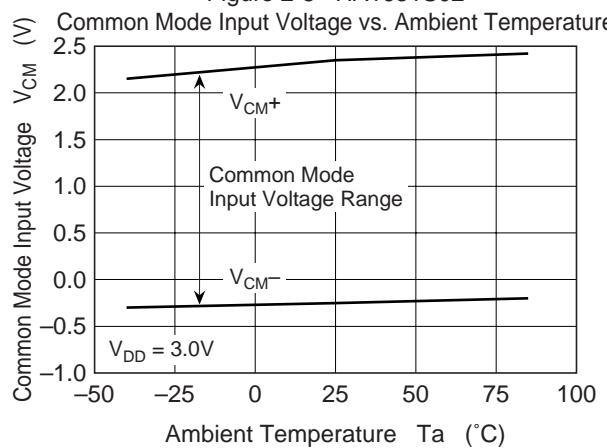


Figure 2-9 HA1631S02

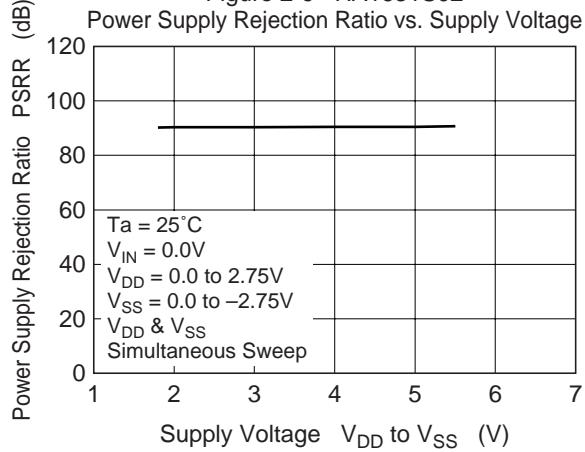


Figure 2-10 HA1631S02

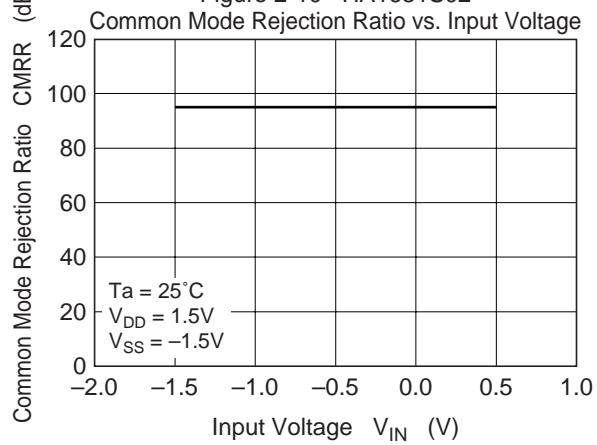


Figure 2-11 HA1631S02

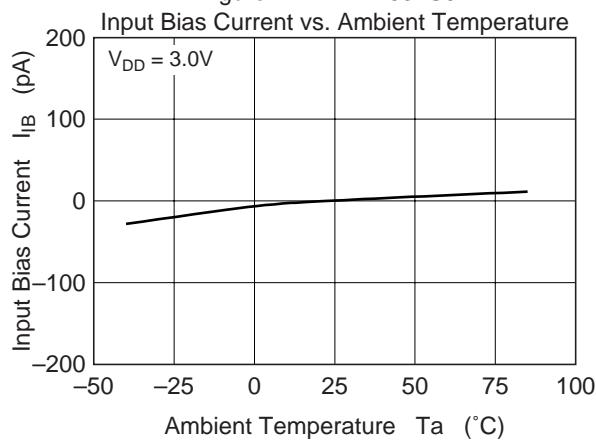
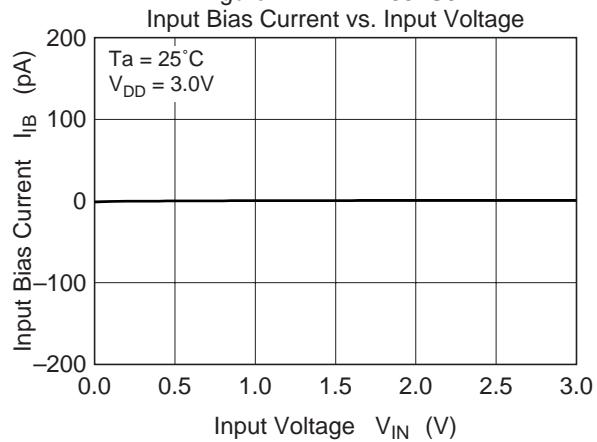


Figure 2-12 HA1631S02



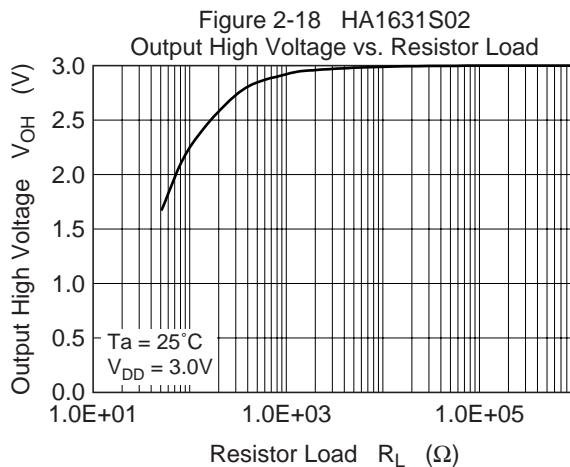
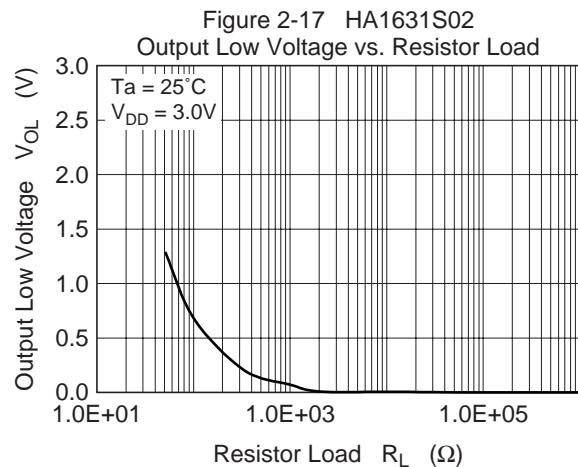
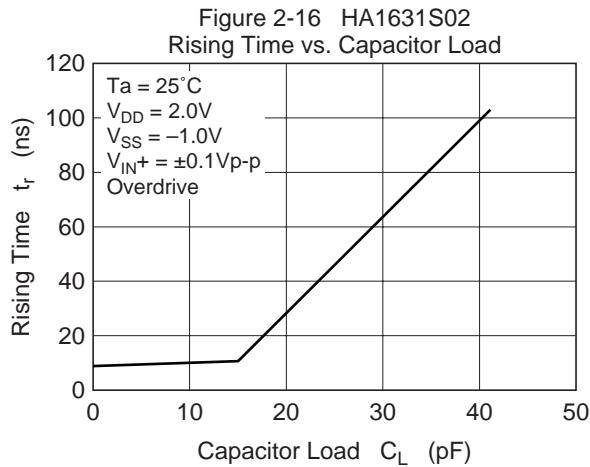
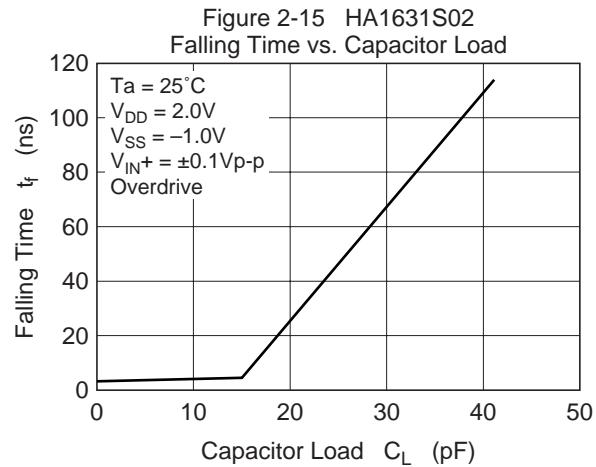
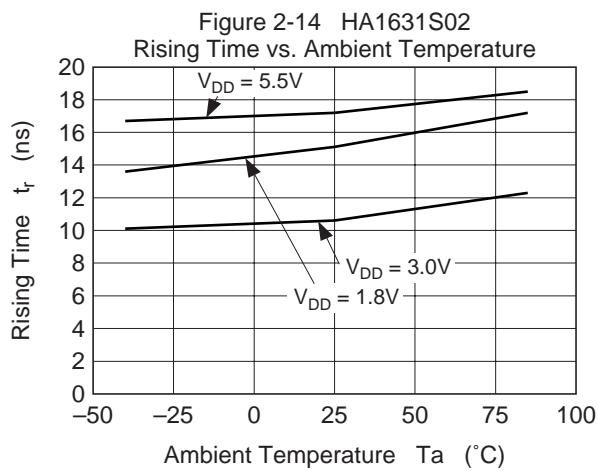
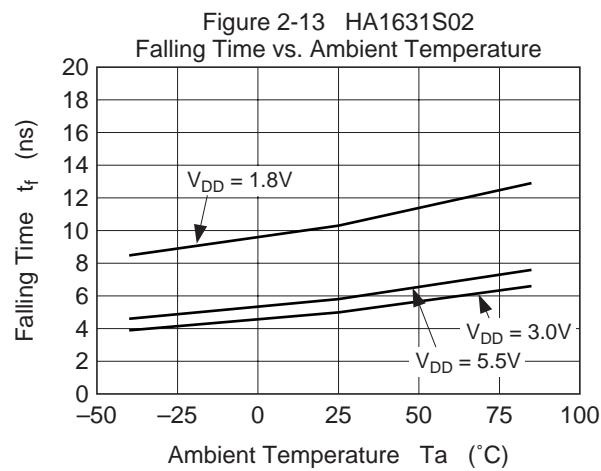


Figure 2-19 HA1631S02
Rising Time, t_r
(Overdrive = $\pm 0.1\text{Vp-p}$)

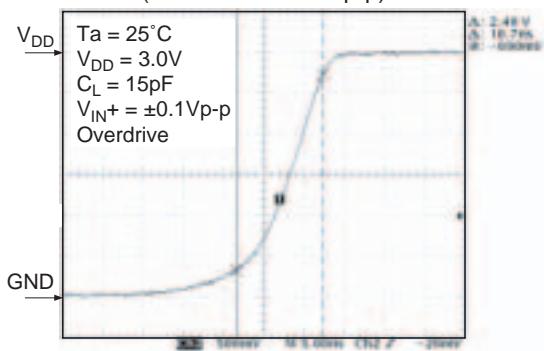


Figure 2-20 HA1631S02
Falling Time, t_f
(Overdrive = $\pm 0.1\text{Vp-p}$)

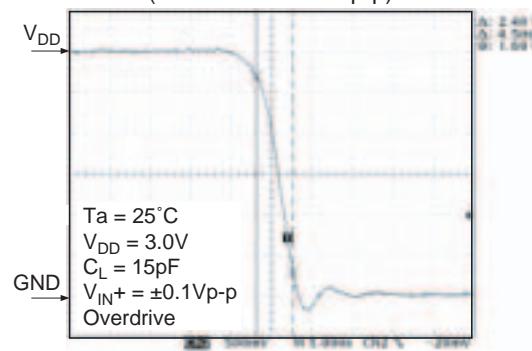


Figure 2-21 HA1631S02
TP_{LH} Transient Response
(Overdrive = $\pm 0.1\text{Vp-p}$)

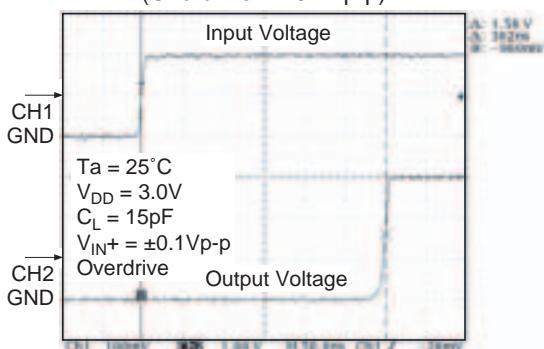


Figure 2-22 HA1631S02
TP_{HL} Transient Response
(Overdrive = $\pm 0.1\text{Vp-p}$)

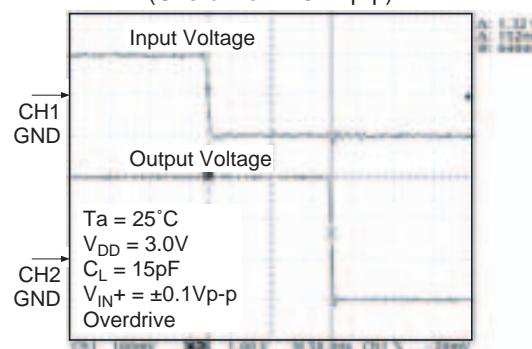


Figure 3-1 HA1631S03
Supply Current vs. Supply Voltage
(Output High)

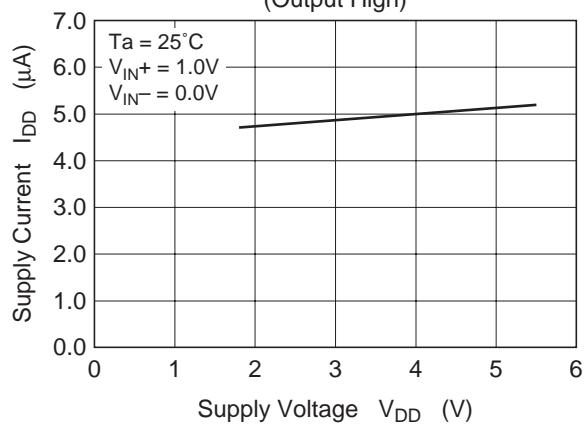
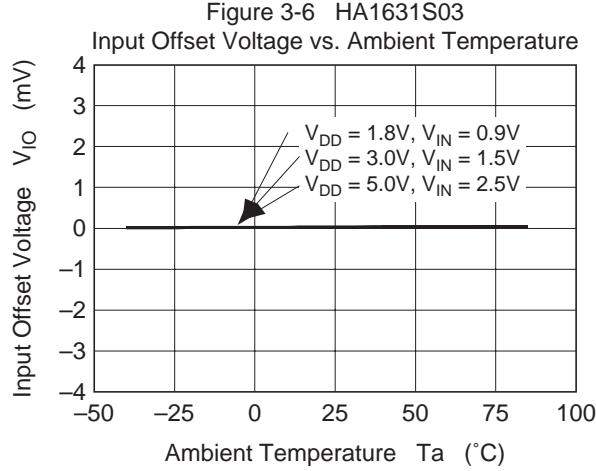
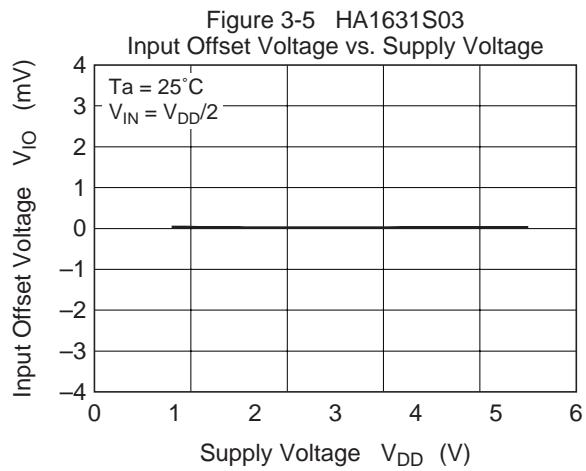
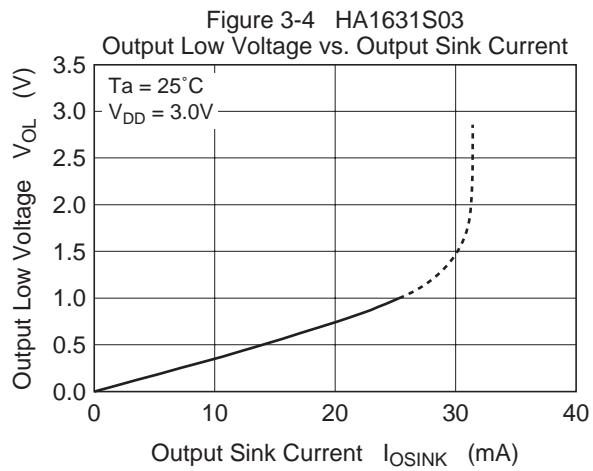
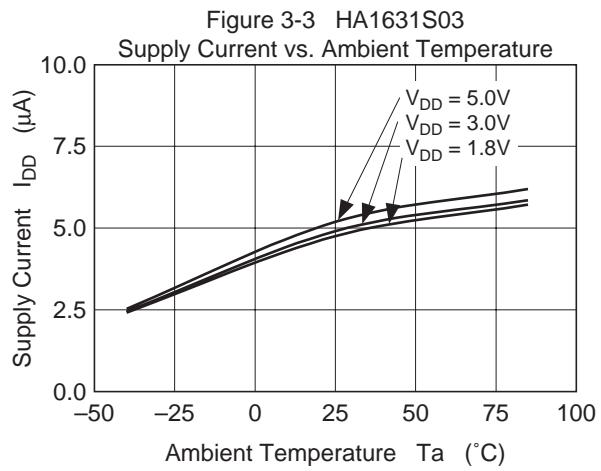
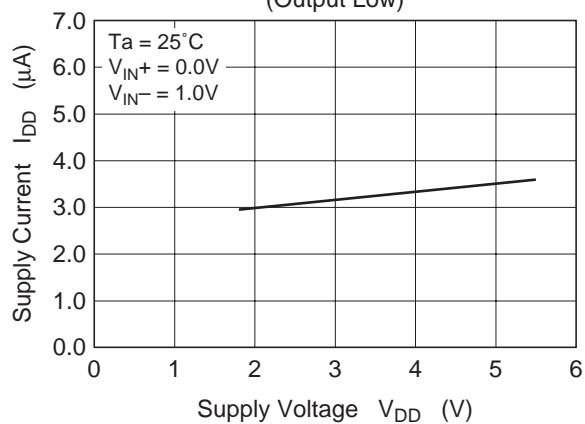
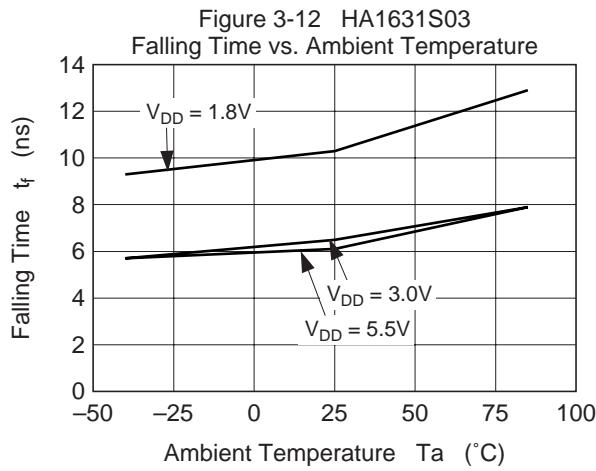
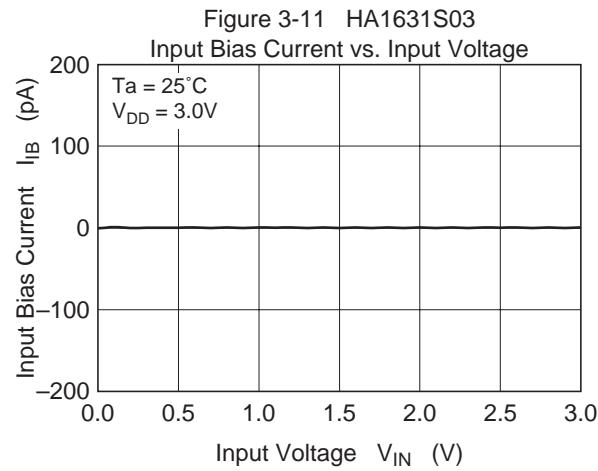
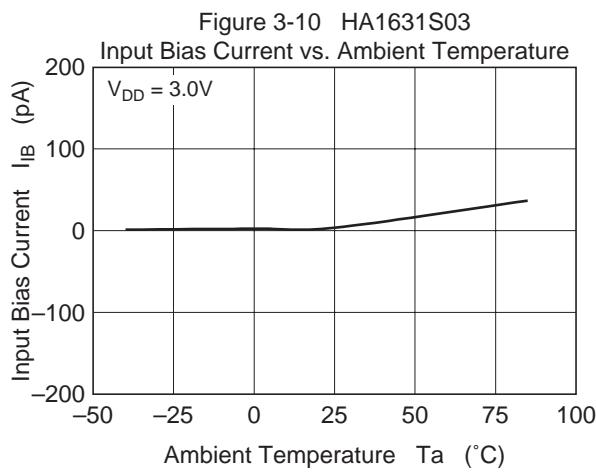
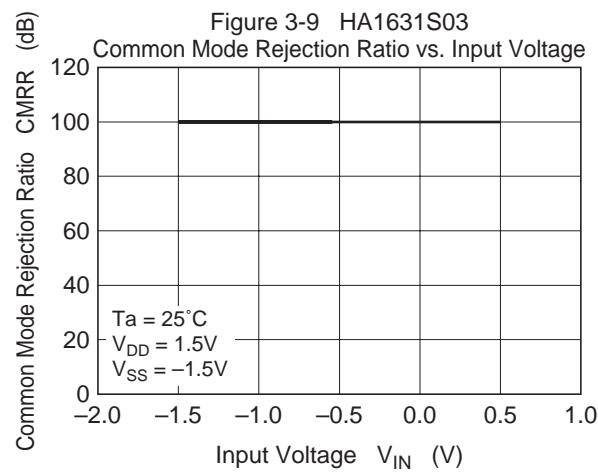
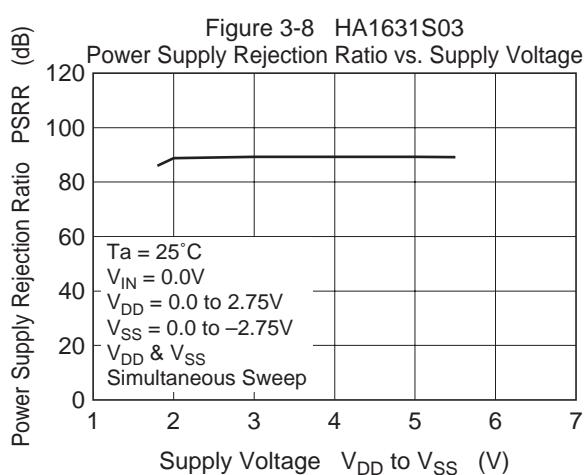
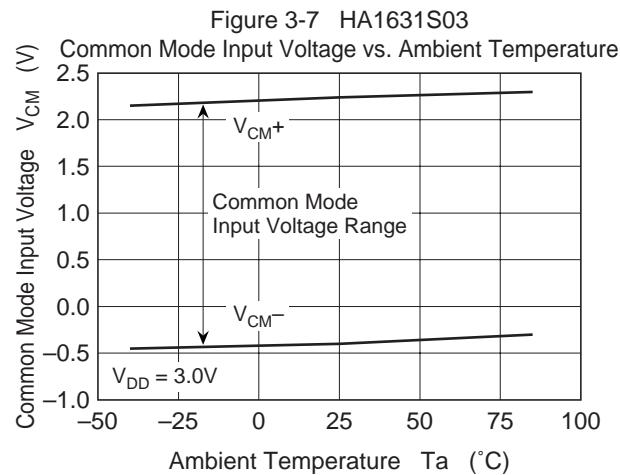


Figure 3-2 HA1631S03
Supply Current vs. Supply Voltage
(Output Low)





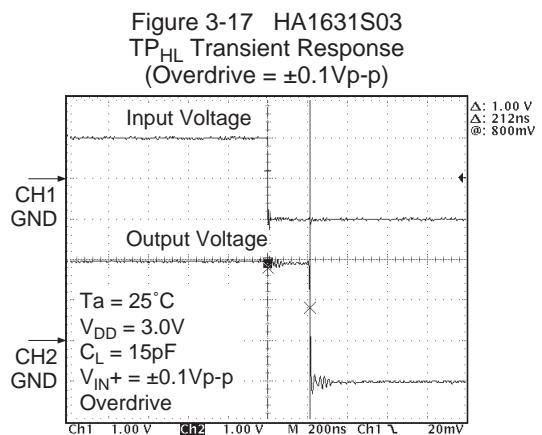
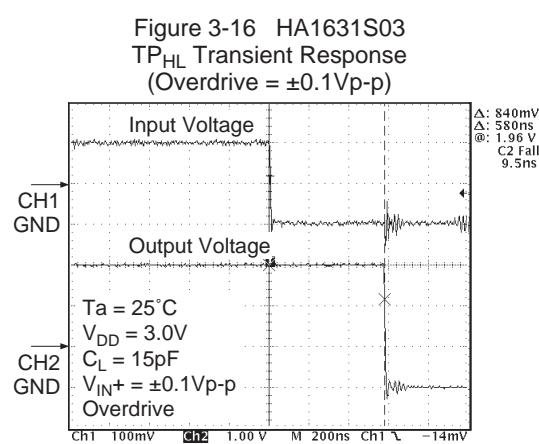
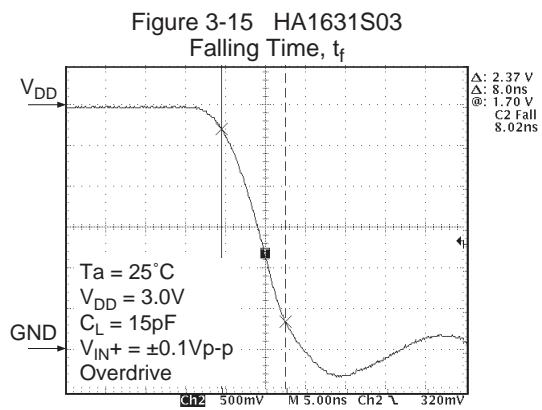
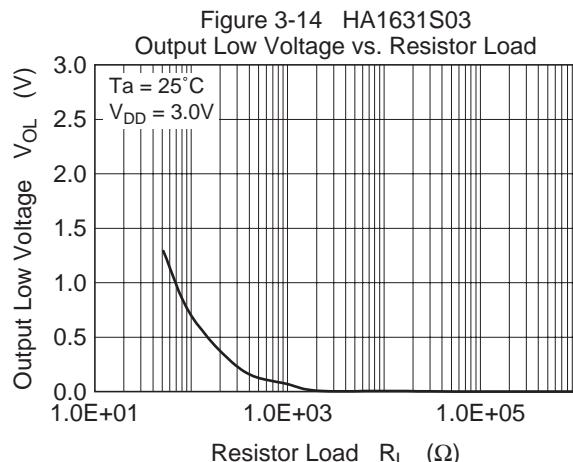
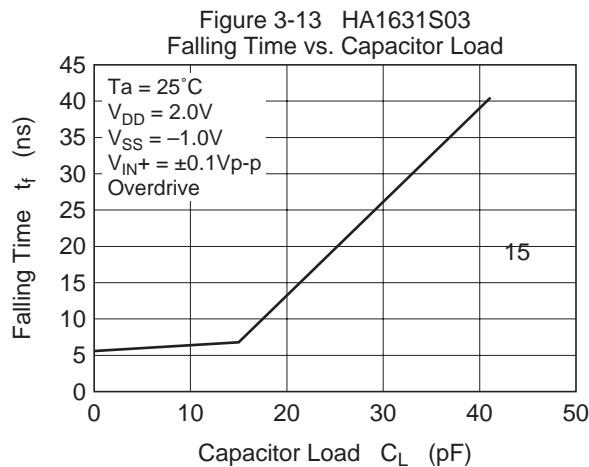


Figure 4-1 HA1631S04
Supply Current vs. Supply Voltage
(Output High)

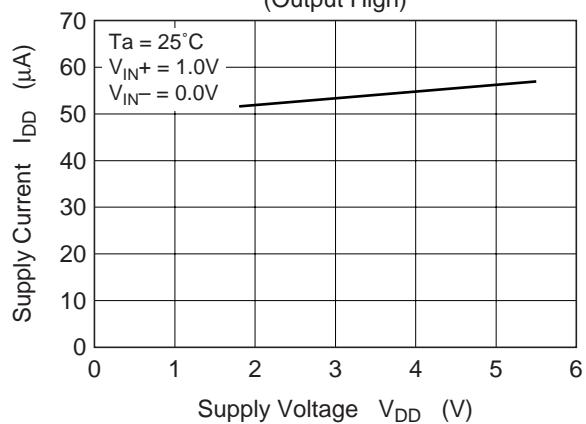
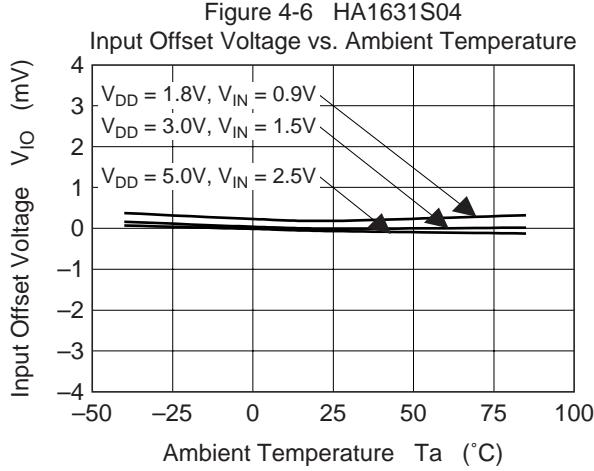
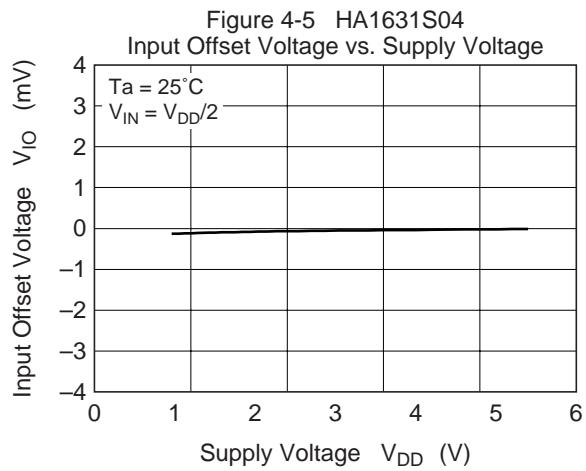
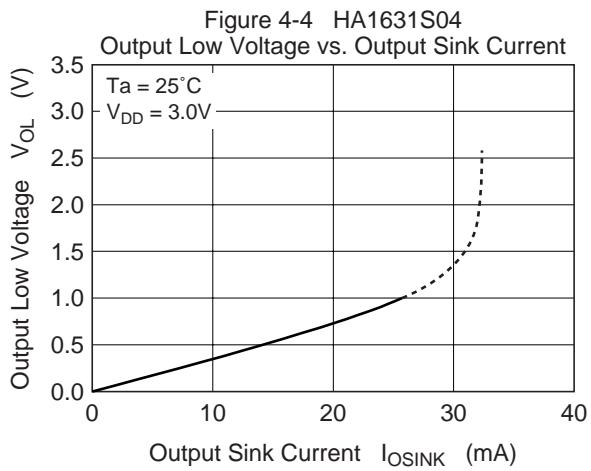
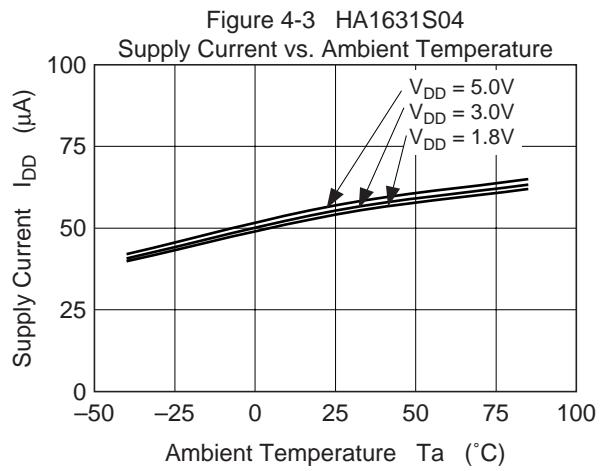
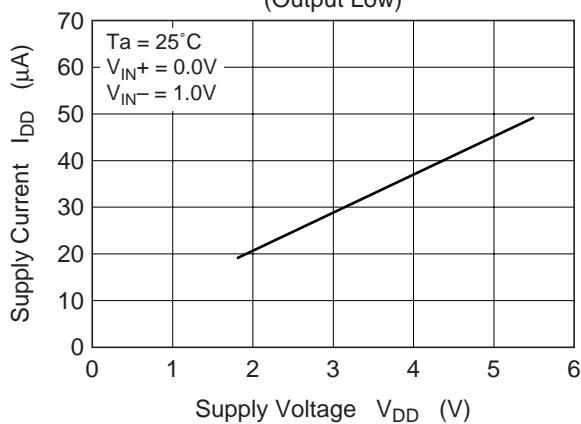
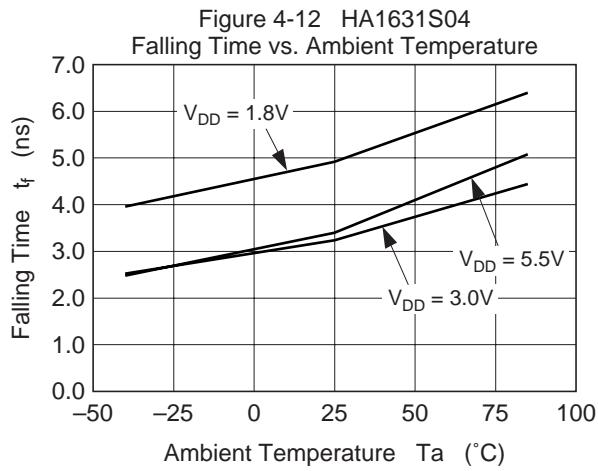
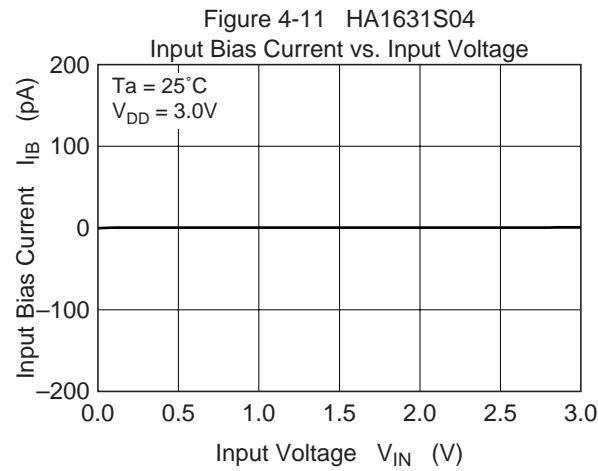
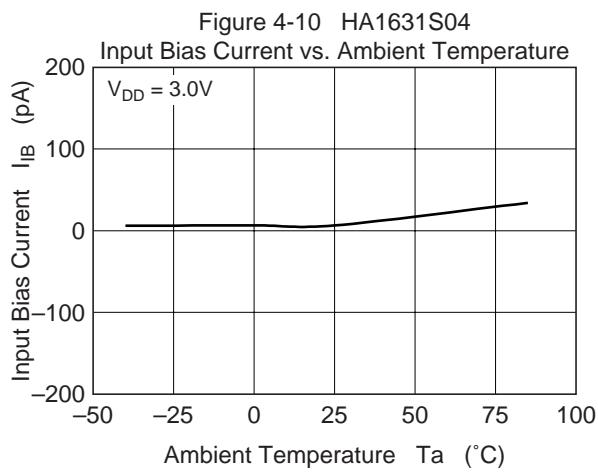
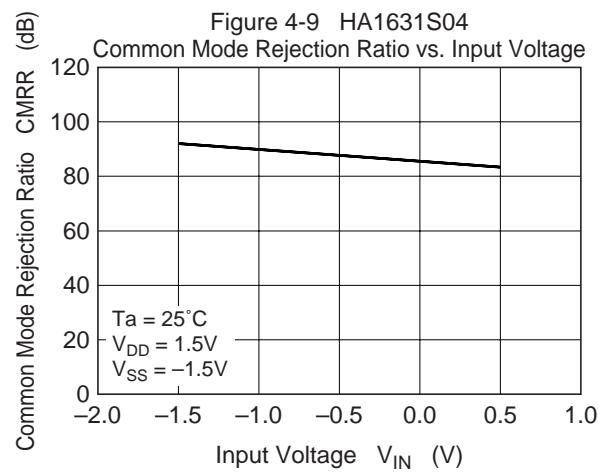
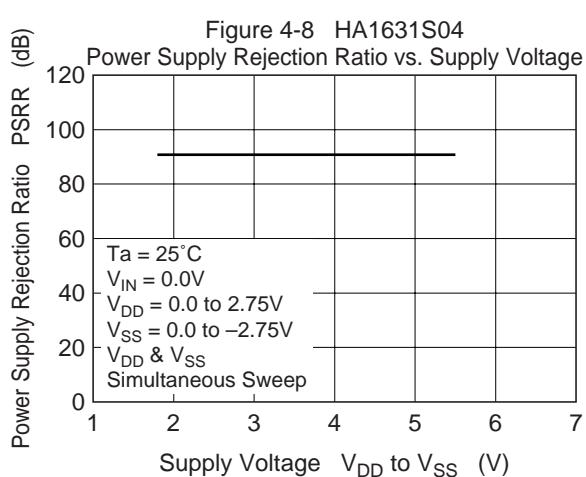
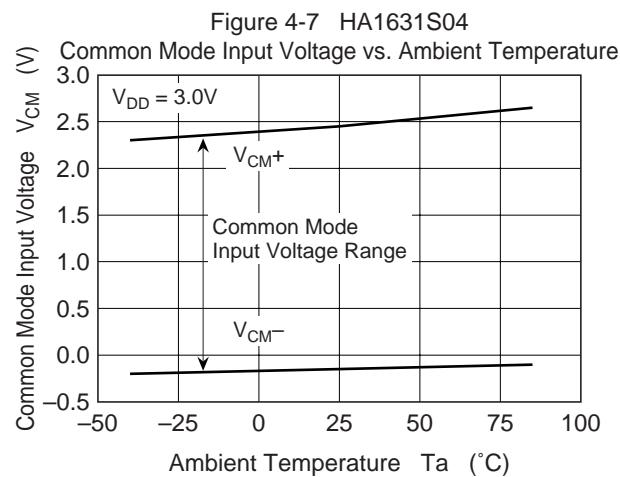
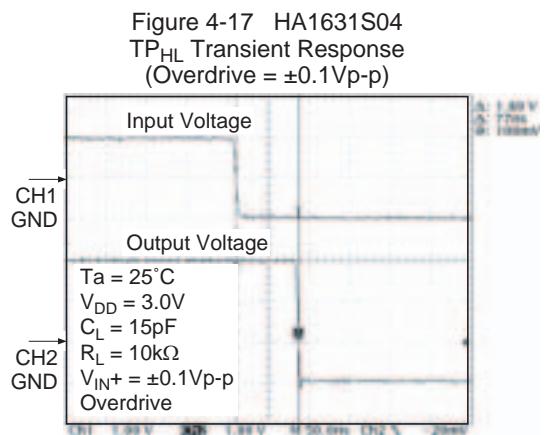
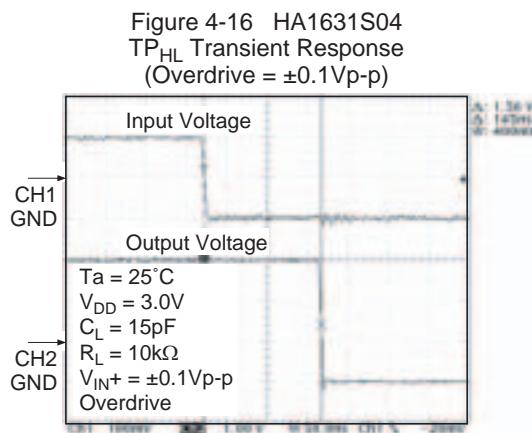
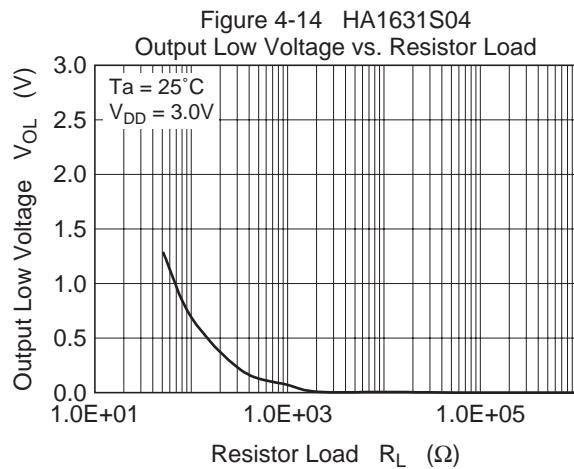
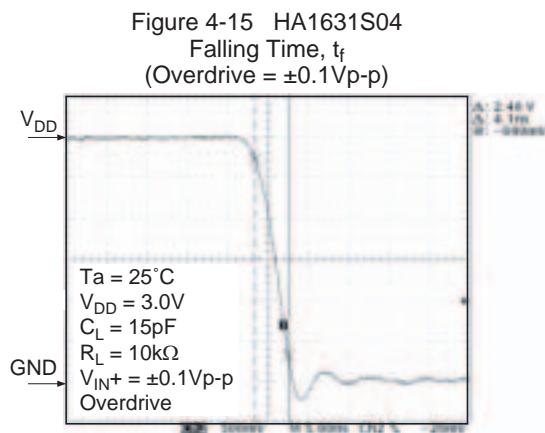
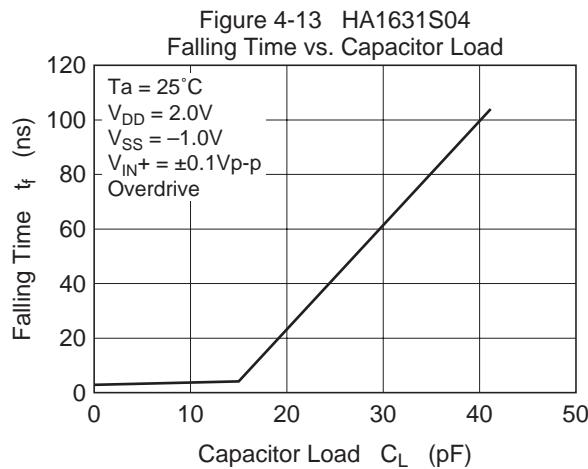


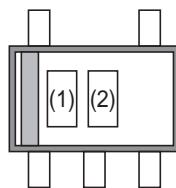
Figure 4-2 HA1631S04
Supply Current vs. Supply Voltage
(Output Low)





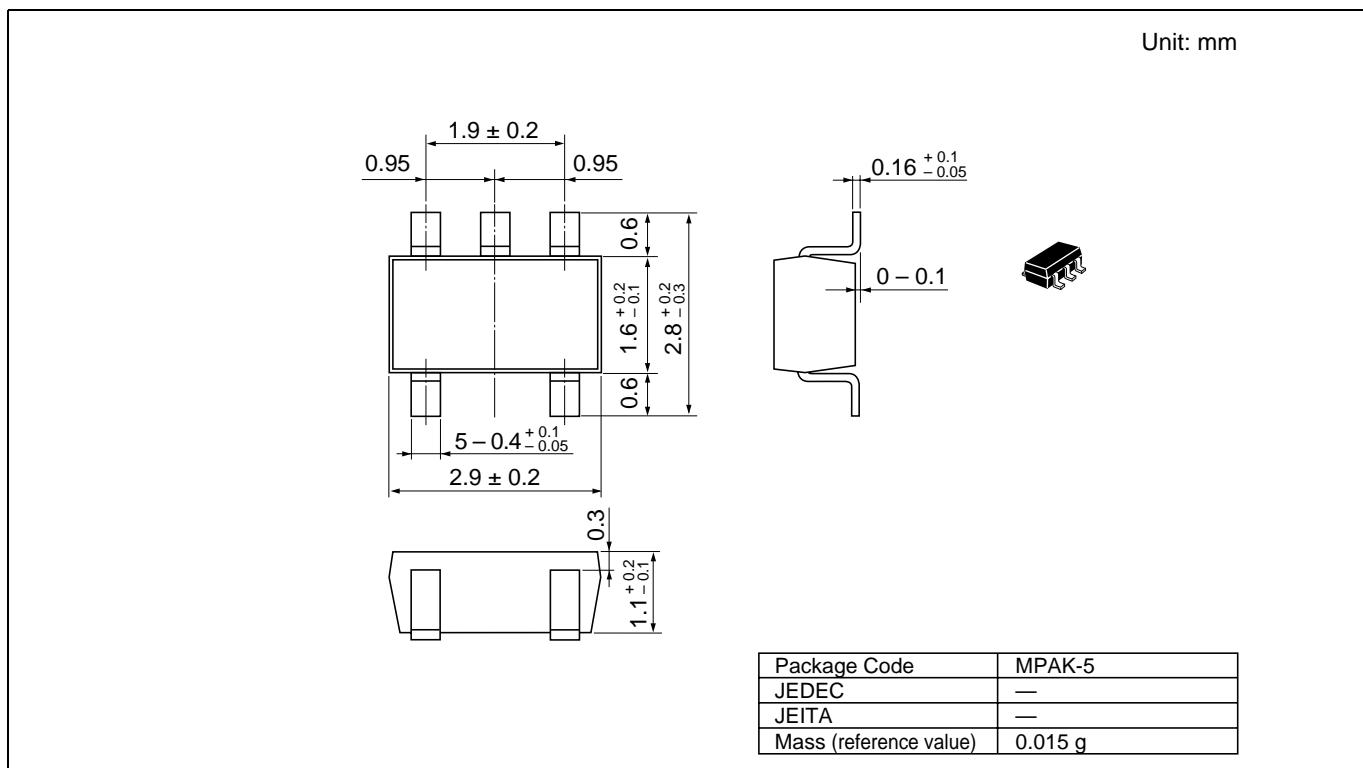
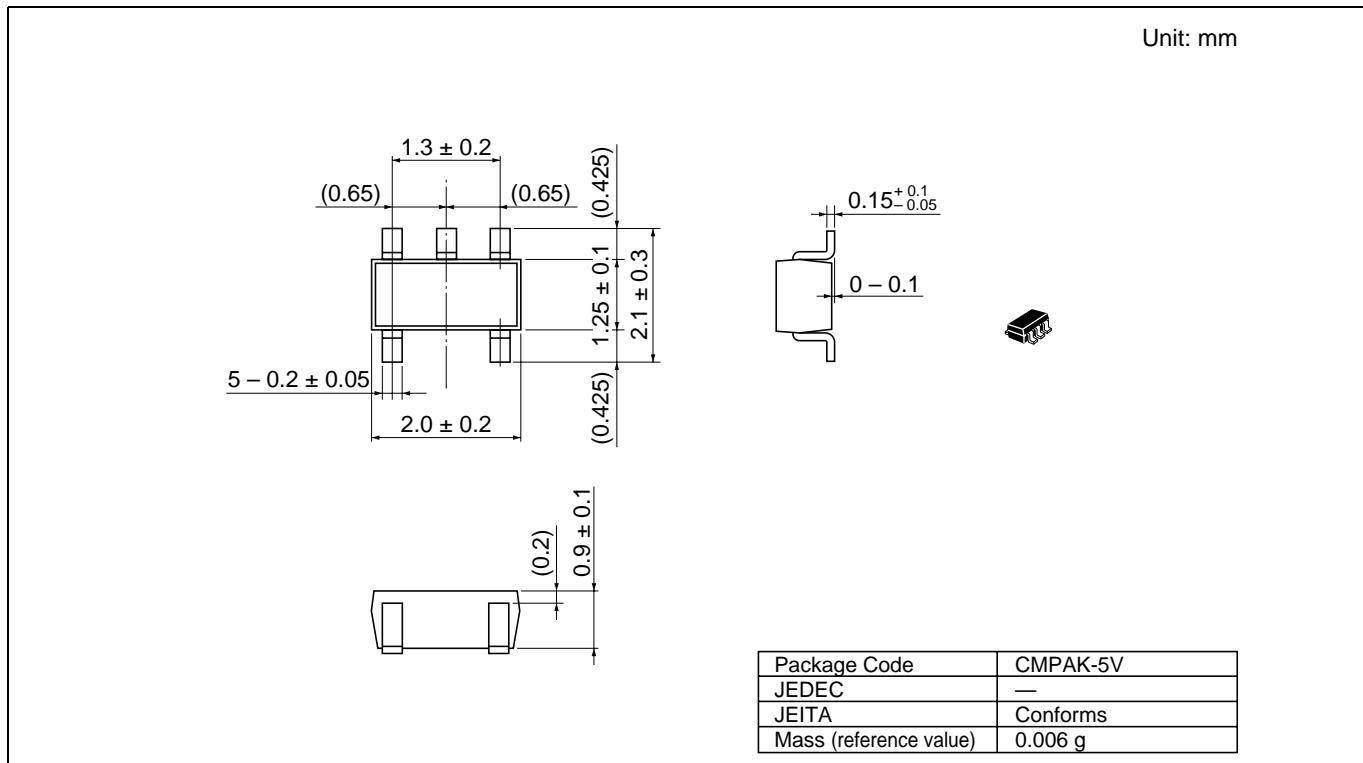


Mark Indication



		(1)	(2)
HA1631S01CM	HA1631S01LP	0	A
HA1631S02CM	HA1631S01LP	0	B
HA1631S03CM	HA1631S01LP	0	C
HA1631S04CM	HA1631S01LP	0	D

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